NASA Activities

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COVER

Most Powerful Communications Satellite—An artist's concept of the Communications Technology Satellite now in synchronous orbit 22,300 miles above the equator. The CTS was launched early this year by a Delta launch vehicle from KSC.
It will serve as the pioneer in a new communications program in which Canada and the United States are partners for a five-year experiment.

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Letter from Washington

Dear Colleagues:

Low

By the time this letter reaches you, you will already know that I have decided to leave NASA in June to become President of Rensselaer Polytechnic Institute. Nevertheless I wanted you to hear from me directly, so that I could tell you that leaving NASA after more than a quarter of a century was one of the most difficult decisions I have ever made, that I will leave with many fond memories, but also with a sense of regret. NASA has been good to me over the years, and I owe it a great deal; at the same time my contributions to NASA stemmed entirely from what I learned at Rensselaer, and when I was asked to lead that organization, I really had no choice other than to accept.

I believe I am leaving NASA at a time when its future opportunities are great. Current projects are well conceived and are being carried out with NASA's usual professionalism—according to standards of excellence which are the envy of most other agencies of government. If you read the studies "Outlook for Aeronautics" and "Outlook for Space," you will know that we have only scratched the surface of all of the things that could and should be done.

In recent months I have learned a great deal about aviation in the United States, and how much the aviation industry depends on NASA technology. I have visited many of our aircraft and engine manufacturers, and have become personally convinced that we will lose our leadership in aviation unless we move forward rapidly with new technological developments. I would, therefore, expect to see renewed emphasis on the first "A" in NASA, and a great push to provide the effort needed to continue to build the best airplanes in the world.

In space we are close to the end of an era, and the beginning of a new age which offers possibilities that most of us have not yet even dreamed about. Of course, I am speaking of the flexibility the Shuttle will provide to create a new beachhead in space, to experiment, to operate, to seek, to explore, and to learn. In a way, I am sad that I will not be able to participate directly in the opportunities that lie ahead, but Jim Fletcher tells me that NASA might even let college presidents fly in the Shuttle.

NASA's strongest asset is its people—the people with the vision to plan what needs to be done; and the people with the skill, the dedication, and the will to carry it out. NASA is very special in this regard: It provides the right kind of environment to do advanced research and to develop the necessary technologies; at the other end of the spectrum it provides the strong discipline needed to be successful in the most difficult of space projects.

Perhaps my most important message to all of you is this: Be disciplined when you must but at the same time seek the freedom to invent and to innovate, to demonstrate what really can be done. This is what has made NASA great in the past, and this is what is needed to assure its future.

One more thought. NASA has contributed not only in aeronautics and space, but also in the overall advancement of technology. We can now demonstrate a very direct relationship between NASA technology and the productivity of the Nation. In turn, our national economy is strongly tied to our productivity. There is no longer any doubt that our future as a nation is inexorably tied to the kind of technology being nurtured by NASA. That is why what NASA does becomes so very important to what happens to the United States in our third century. That is also why I felt I had to accept the challenge of the presidency of Rensselaer. With that challenge comes the opportunity to contribute directly to the education of the next generation of scientists and engineers for our Nation, and perhaps even to some of the next generation of NASA's leaders.

Good luck, and my very best wishes for many new achievements in the years ahead.

Sincerely,

George M. Low

George M. Low

Deputy Administrator's Departure from NASA

"I know of no other person who has contributed as much to achieve and maintain United States leadership in space exploration than Dr. George M. Low," said NASA Administrator James C. Fletcher. "His influence on the manned space flight program from the very beginning of NASA, his courageous decisions in the Apollo program, his direction of the agency's programs toward the practical application of space technology, and his initiatives in the development of international cooperation in space have earned the admiration and gratitude of the entire country."

Low, a graduate of Rensselaer and a Trustee of the Institute since 1971, has been NASA Deputy Administrator for the past six years. With the exception of one year as an aerodynamicist with General Dynamics in Fort Worth, Texas, in 1948, Low's entire professional career has been with the space agency and its predecessor, the National Advisory Committee for Aeronautics.

Low joined NACA at the Lewis Flight Propulsion Laboratory in Cleveland, Ohio, as an aeronautical research scientist in 1949. Nine years later, when NASA was organized, he came to its headquarters in Washington as Chief of Manned Space Flight. He was chairman of the special committee that formulated the original plans for the Apollo manned lunar landing program.

He later became Deputy Associate Administrator for Manned Space Flight before transferring to the NASA Manned Spacecraft Center, Houston, as Deputy Director, in February 1964.

In April 1967, after the Apollo 204 fire, Low was named Manager of the Apollo Spacecraft Program. Under his leadership the Apollo spacecraft was redesigned and manned space missions resumed in October 1968 after a lapse of 23 months. He then accelerated the Apollo timetable and brought Apollo 8 into the program as man's first flight into lunar orbit. Under his direction, Apollo 11 made the first manned lunar landing in July 1969.

Appointed Deputy Administrator of NASA by the President in December 1969, Low also served as Acting Administrator from September 1970 to May 1971. He has guided the agency in the transition to the new goals of the 1970s and beyond, and has negotiated the space agreements with the Soviet Union which led to the Apollo-Soyuz joint flight and other cooperative space projects.

Low is a Fellow in the American Institute of Aeronautics and Astronautics, a member of the National Academy of Engineering and a member of several other engineering and technical societies. He received an honorary degree of Doctor of Engineering from Rensselaer and an honorary Doctor of Science degree from the University of Florida in June 1969.

Among the other honors Low has received are two NASA Distinguished Service Medals for his contributions to Apollo 8 and for his work in the Apollo program; NASA's Outstanding Leadership Medal for his contributions to Project Mercury; the Arthur S. Flemming Award as one of the 10 outstanding young men in Government in 1963; the Robert H. Goddard Memorial Trophy in 1973; the National Civil Service League's 1973 Career Service Award for Sustained Excellence in 1973 and the Rockefeller Public Service Award (for Administration) in 1974.

Low attended Rensselaer and received a Bachelor of Aeronautical Engineering Degree in 1948 and a Master of Science in Aeronautical Engineering Degree in 1950.

Low was born in Vienna, Austria, June 10, 1926. He came to the United States in 1940, served in the U.S. Army from 1944 to 1946 and became a citizen in 1945.

Congressional Visitors at MSFC—Rep. Don Fuqua (Fla.), chairman of the Subcommittee on Space Science and Applications, took time out from recent hearings at the Marshall Space Flight Center to hold a brief press conference. In background are (left to right) MSFC director Dr. William R. Lucas, Huntsville's Mayor Joe Davis and Subcommittee Member Rep. Larry Winn, Jr. (Kan.). Rep. Fuqua answered questions asked by local reporters as to the NASA budget, the state of the Alabama center and the outlook for the national space program.

Monthly NASA Highlights

First Marisat Successfully Launched

Marisat-A, the first in a series of three maritime communications satellites, was launched on a Delta launch vehicle from the Eastern Test Range on Feb. 19. The launch support for the mission was provided by NASA on a fully reimbursable basis to Comsat General, a subsidiary of the Communications Satellite Corporation.

The Delta launch vehicle performance was normal and placed the spacecraft into the desired synchronous transfer orbit. The spacecraft is on station above the Atlantic Ocean about 500 miles southwest of the coast of Liberia. Marisat-B, scheduled to be launched later this year, will be positioned over the Pacific Ocean.

The satellite system will permit rapid, high-quality communications between ships at sea and home offices on the shore. The system will provide voice, data, facsimile, and telex services to ships at sea without interference or delay because of severe weather or ionospheric disturbances that sometimes interrupt radio traffic.

The Delta project is managed for NASA's Office of Space Flight by the Goddard Space Flight Center. Launch operations are conducted by the Kennedy Space Center's Expendable Vehicles unit.

Communications Satellite in Orbit—Marisat-A was launched from the Kennedy Space Center via a Delta 120 rocket in mid-February, in a virtually flawless flight. The spacecraft is now in its planned orbit 22,300 miles above the equator in the Atlantic Ocean. Marisat is a Comsat Corporation satellite.

Seventh Lunar Science Conference

Several hundred scientists from the United States and abroad gathered in Houston for the Seventh Lunar Science Conference held at NASA's Johnson Space Center during the week of March 15. The conferences have been held annually since 1970 when the first conference assembled to hear the scientific results from the first manned lunar landing mission, Apollo 11.

This year's conference included topics of more general planetary interest. Discoveries made about the Moon are being applied to deciphering the origin and early history of the solar system. The fact that Moon rocks are beginning to tell us something about other planets is a very exciting aspect of lunar research. Bodies like the Moon, Mars and Mercury were apparently formed in similar fashion, and their early histories are dominated by the impacts of large bodies and by widespread inner melting. Several scientists described how lunar data can be used to interpret the craters and volcanoes on the surfaces of Mercury and Mars recently photographed by spacecraft.

Scientists in such diverse fields as geology, chemistry, physics, astronomy, engineering and biology attended the Lunar Science Conference, which is sponsored jointly by the Johnson Space Center and the Lunar Science Institute, Houston.

Delta Achievements Are Applauded

Forty-five members of the "Delta team" received awards at the Goddard Space Flight Center recently as NASA officials Drs. James C. Fletcher and George M. Low praised the Delta rocket as one of the agency's most dependable launching systems.

Among the awards received were: Distinguished Service Medals to Isaac T. Gillam of NASA Headquarters, to Charles R. Gunn and William R. Schindler (ret.) of the Goddard Center, and to John J. Neilon of the Kennedy Space Center. Winners of the Distinguished Public Service Medal were Edward W. Bonnett and Theodore D. Smith, McDonnell Douglas Corp.

Dr. Fletcher said: "The Delta program has been managed by an outstanding government-industry team, and that team's record of accomplishment is one of the most remarkable in NASA's two decades of existence. . . . The legacy of Delta has indeed been a rich one. Delta is becoming a standard against which to measure the conduct of NASA's business in the future. We are extremely proud of this team."

From 1960 to January 1976, 110 of the 119 Delta launches have successfully placed satellites into orbit. The number of Delta launch vehicles used for reimbursable missions has steadily increased. Eleven Delta missions are planned for 1976, and all but two of them are on a reimbursable basis.

Delta placed NASA's first communications satellite, ECHO-1, into orbit Aug. 12, 1960, an event that was followed by a series of launches of communications, meteorological and scientific satellites. Because of the rocket's reliability and economy, it attracted a wide array of users over the years, to become the primary launch vehicle for commercial spacecraft, international users and operational meteorological systems.

Ion Thruster Sets Endurance Mark

Electric propulsion research was significantly advanced as engineers at NASA's Lewis Research Center passed an old world record with the completion of 15,000 hours of successful operation of an eight-centimeter mercury ion thruster.

The tests, initiated in the summer of 1973, sought to evaluate ion chamber erosion and the peeling of sputtered metal observed in previous life tests, to determine the reliability of thrusters under cyclic operation, and to identify longer term failure modes not apparent in shorter tests.

During the 15,000 hours of operation, Lewis engineers performed 460 re-starts over a 26-month period.

"The re-starts demonstrated that ion thrusters can be started up and shut off without a discernible change in performance," said project engineer Shigeo Nakanishi.

Nakanishi explains the importance of electric propulsion to NASA research and how ion thrusters fit into the overall picture:

"Over the past decade, auxiliary propulsion requirements for geosynchronous spacecraft such as communications satellites have resulted in a need for lightweight, highly reliable thruster systems that can run for years. Electric propulsion devices use less propellant, thus saving space and weight for additional payload such as more communications channels on a communications satellite. Our tests are aimed at further demonstrating thruster reliability and durability."

The Lewis Center has made considerable progress in demonstrating the flight readiness of the mercury ion thruster. The thruster was first tested in space more than a decade ago. The test proved that neutralizing ion beams in space occur as predicted in vacuum tests. Ion beams must be neutralized to reduce the accumulated positive electric charge that would prevent the thruster from operating.

Thruster durability was tested in space with the Lewis-built Space Electric Rocket Test II spacecraft in 1970. Two mercury ion thrusters operated successfully

for 2,011 and 3,781 hours before developing electrical shorts. The ability of thruster cathodes to operate after long term storage was demonstrated when the thruster systems were shut off for 15 months. A series of 188 cathode start-up cycles were successfully performed when operations were resumed.

Apollo 14 ALSEP Is Operational

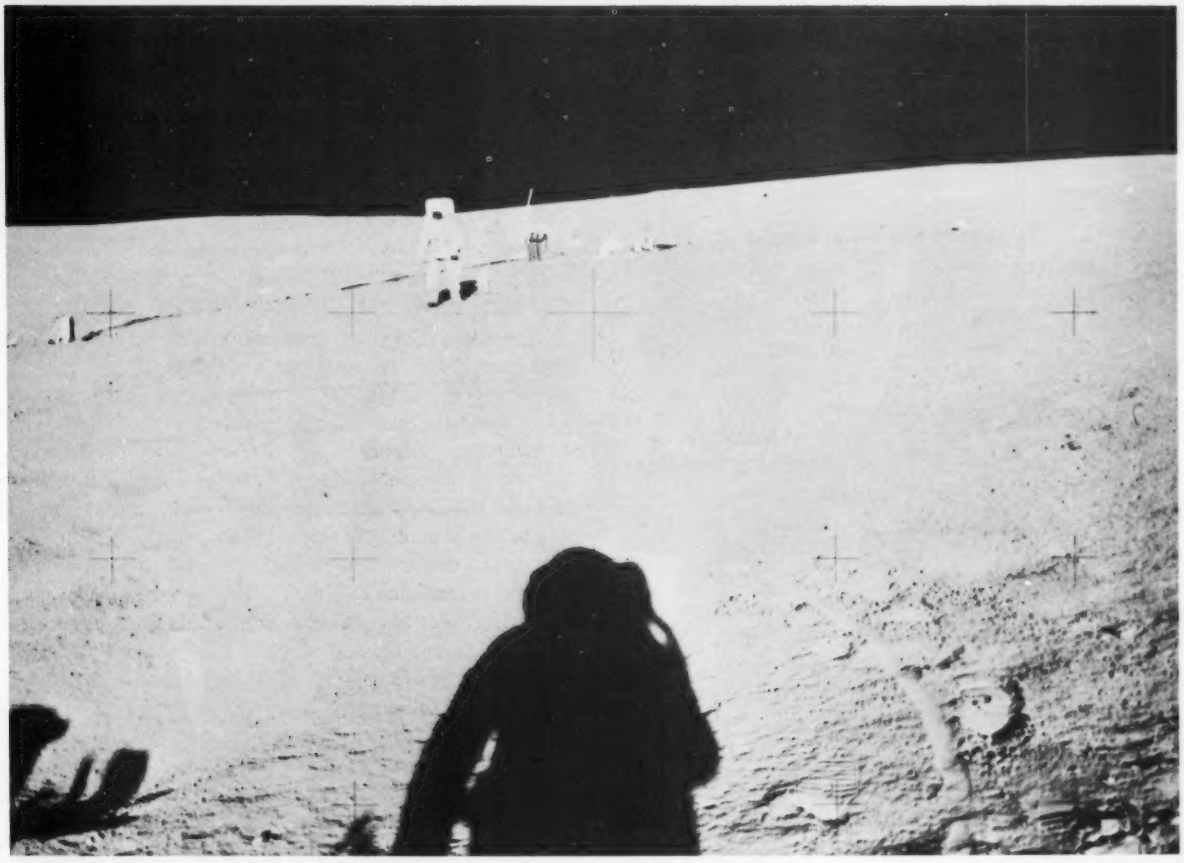
The Apollo 14 Apollo Lunar Scientific Experiment Package (ALSEP) is one of five remote scientific stations transmitting data from the Moon. The station was set up by Alan B. Shepard and Edgar D. Mitchell during their lunar visit in Feb. 1971.

On Jan. 18, 1976, the Apollo 14 ALSEP stopped transmitting. Scientists and engineers at the Johnson Space Center were disappointed and puzzled inasmuch as there was no data to indicate that the station was headed for extinction. It had operated for about five years and had an estimated remaining life of from two to three years. The ALSEPs from Apollo 12, 15, 16 and 17 were still performing well.

The JSC scientists and Bendix engineers who designed the stations are even more puzzled now, because the Apollo 14 ALSEP resumed transmission on Feb. 19. The experiments are now functioning extremely well and the ALSEP team at JSC cannot explain why the station came back on; in fact, they still haven't determined why it stopped transmitting last month.

The ALSEPs were designed to operate for only one year, and all the stations have exceeded their original design life. The Apollo 12 ALSEP, the oldest station, is nearing its seventh year of operation.

Not all of the experiments at each station are operational, but the majority of the experiments are providing Earth-based geoscientists with invaluable information on the Moon's thin solar atmosphere, conditions within the Moon and Moonquakes.



Only Yesterday—Apollo 14 lunar module pilot Edgar D. Mitchell carries the Penetrometer toward crewmate Alan B. Shepard (shadow) while erecting the Apollo Lunar Surface Experiment Package at Fra Mauro in 1971. The Apollo 14 ALSEP died, then revived, last February.

Pioneer 10 Passes By Saturn's Orbit

Four years after launch and nearly a billion miles from Earth, Pioneer 10 crossed the orbit of Saturn last February, enroute to the edge of the solar system. The satellite will leave our planetary system altogether in 1987 when it crosses the orbit of Pluto, some 6 billion kilometers (3.6 billion miles) away. It will then become a drifter in space probably for countless millenia, encountering other star systems every million years or so. Pioneer 10 carries a message to any intelligent beings that might retrieve the craft. It should remain in good condition in the vacuum of space though its nuclear power source will die in a few decades.

Project officials say that Pioneer's signals will continue to be detected by the sensitive "big dish" antennas of NASA's Deep Space Network as far out as, and perhaps even beyond, Uranus' orbit, to be reached in 1979 when the spacecraft is 3.2 billion km. (2 billion mi) from Earth.

Pioneer 10 completed the first leg of its space marathon in December 1973, when it flew past Jupiter and provided man with his first closeup view of the giant planet. Since then, systems aboard the 256-kilogram (570-pound) spacecraft have continued to work well. Pioneer is returning valuable data about the character of the interplanetary medium in the unexplored space beyond Jupiter's orbit. The satellite also is studying the interstellar medium, cosmic rays, and the abundance of elements in interstellar space, all of which are important to research on the origin and evolution of our universe.

Pioneer 11, sister spacecraft to Pioneer 10, is now making the first trip to the planet Saturn, with an estimated time of arrival September 1979.

The Pioneers are managed for NASA's Office of Space Science by the Ames Research Center. ■ ■ ■ ■ ■

Advanced Aircraft Under Development—A joint NASA/Army project was the subject of a recent meeting between representatives of NASA and the U.S. Army Air Mobility R&D Laboratory at Moffet Field, Calif. Under development at the laboratory is the tilt rotor aircraft (XV-15), which is scheduled for rollout next fall. Seated in the center of the picture is Dr. James C. Fletcher. Surrounding him left to right are Col. Norman L. Robinson, AMRDL deputy director; Dr. Irving C. Statler, AMRDL Ames Directorate director; Dr. Hans Mark, NASA/Ames director; Dr. Richard M. Carlson, AMRDL director; and Dr. Leonard Roberts, NASA/Ames Aeronautics and Flight Systems director.

Satellite to Monitor Earth's Crust

A geophysics research satellite expected to survive in space for several million years passed scientific testing recently at NASA's Goddard Space Flight Center preparatory to a May launch from the Western Test Range. LAGEOS (for Laser Geodynamic Satellite) is expected to be of significant aid to scientists seeking to predict earthquakes.

LAGEOS, which looks like an oversized shiny golf ball, is designed to become a stable point in the sky to reflect pulses of laser light back to their point of origin on Earth. By timing the return of the laser beam to an accuracy of about one 10-billionth of a second, scientists expect to be able to measure the relative location of participating ground stations to within a few centimeters (about an inch). In other words, LAGEOS' ultra-sensitive instrumentation will be capable of detecting extremely slight movements of the Earth's crust. Using the LAGEOS data, scientists can develop and improve models that deal with Earth's crustal motion and changes in the structure of the Earth's crust. Such models in time will help to predict earthquakes.

The satellite is 60 centimeters (2 feet) in diameter, weighs 411 kilograms (906 pounds), and carries 426 special reflectors that bounce back laser pulses to the exact source from which they were beamed outward. A major laser tracking station is located at the Goddard center.

The LAGEOS project is managed for NASA's Office of Applications by the Marshall Space Flight Center.

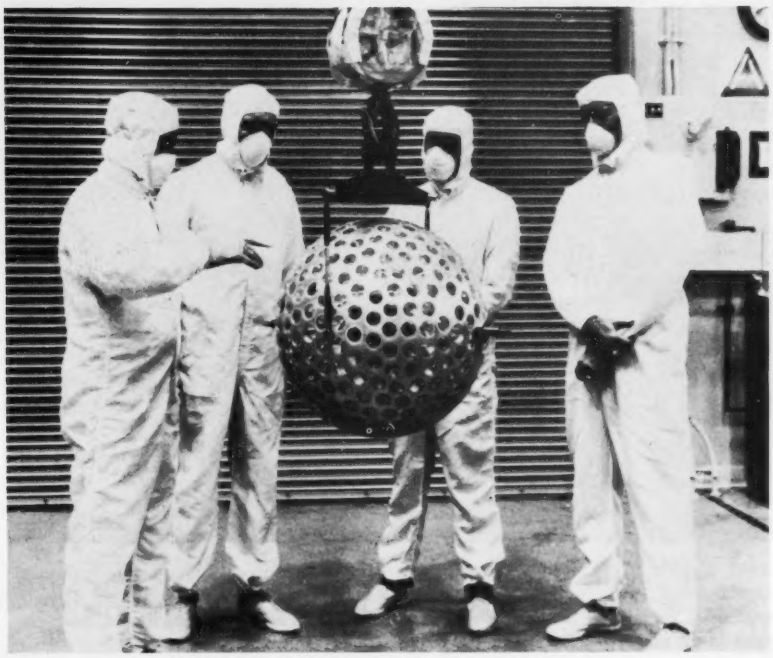
Spacecraft Sterilization Method Maintains Human Blood

A promising system for transferring blood from one container to another in blood banks without risking the accidental introduction of impurities has been devised by a team of scientists and engineers at NASA's Jet Propulsion Laboratory.

The work is performed under contract to the National Heart and Lung Institute of the National Institutes of Health, Bethesda, Md. NASA spacecraft sterilization techniques gave rise to the concept, called the Aseptic Fluid Transfer System, which was developed at JPL by the biomedical team of Dr. Richard M. Berkman, James C. Arnett and Edward L. Cleland. The AFTS will be used in blood banks primarily.

"Present transfer systems employed in blood banks do not insure sterility, hence frozen-thawed blood must be used within one day or be discarded," team leader Berkman said. "Our evaluation of the AFTS shows virtually no contamination—less than 0.001 percent. Our heat fusion process kills off any microbes on the connecting tubes." He said that the method may more than triple the safe storage time of blood.

The key to the AFTS is a double-walled connector tube, fused and made sterile by high heat (200 degrees C., or 400 degrees F.), which allows for the clean transfer of blood from one container or bag to another after the whole blood has been thawed. (Blood is sterile throughout the transfusing process, and kept that



Unique Spacecraft Tracks Cracks—NASA and Bendix employees wear cleanroom attire at the Marshall Space Flight Center as they scrutinize the Laser Geodynamic Satellite after its retro-reflectors were installed at the Bendix Corporation plant at Ann Arbor, Mich. To be launched in April, the LAGEOS will be tracked by laser for accurate measurements of crustal and rotational motions of Earth. Optical testing of the satellite was completed recently at the Goddard Space Flight Center.

way while in the frozen state; the risk of contamination comes when the thawed blood must be repackaged.)

When the transfer process begins, heat is applied through a metal clamp affixed to the flat end-links of the tubing; within a minute, blood can be passed through the sterile joining and into a second container with only the slightest risk of taint by microorganisms. The heat is applied to the heat-resistant kapton tubes by an electrically powered device about the size of a hand-held hair curler. NASA studies have shown that even when tube surfaces were purposely contaminated with large quantities of bacteria, sterility was completely restored by use of the AFTS.

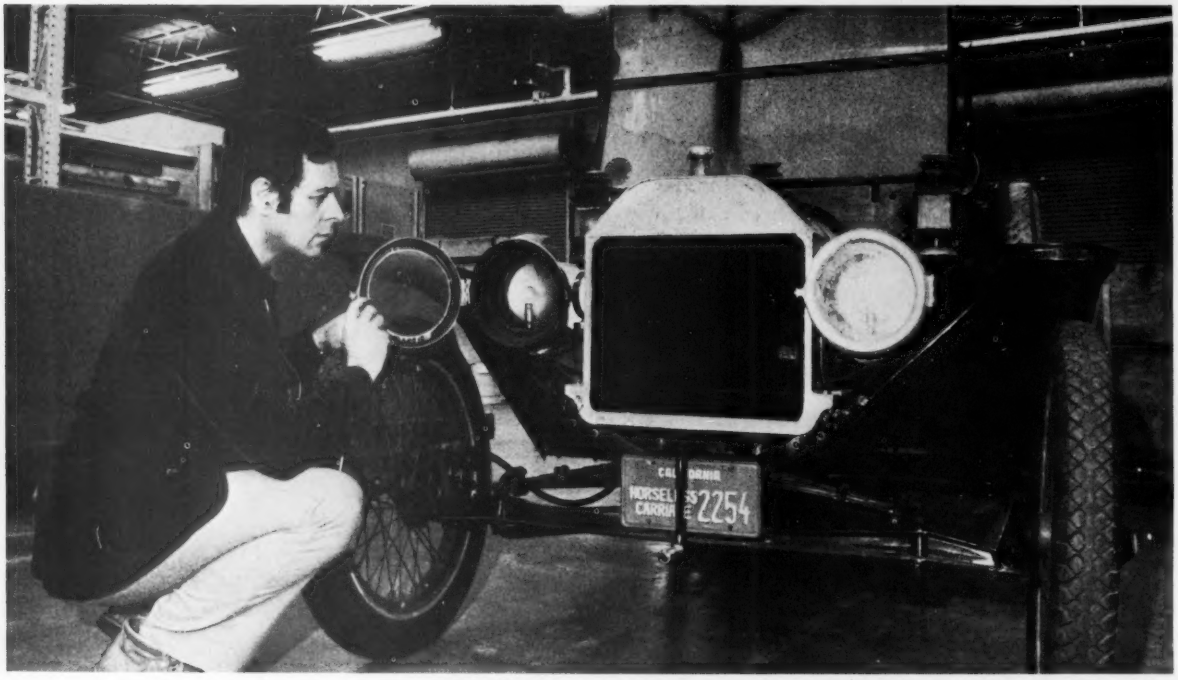
The system will be tested clinically by pathologist Dr. Byron Myhre at Harbor General Hospital, Torrance, Calif., during the next several months. He characterized the system as having "very great possibilities."

An Odd Couple

A "Tin Lizzie"—a model-T Ford—will team up with NASA's Nimbus-6 meteorological research satellite next summer, the former to drive across the world in a point-to-point auto race, the latter to track the 1914 Ford automobile's traveling patterns and speed. Not a frivolous venture, the tracking operation offers NASA's Goddard Space Flight Center an opportunity to assess the advantages of an expanded usage of the Nimbus system that ordinarily collects environmental data as the craft passes over data-collecting platforms such as balloons and buoys.

Nimbus-6 orbits the globe from pole to pole every 108 minutes. During the 1976 racing event—called the Bicentennial Around-the-World Auto Race—the Model-T Ford will be equipped with a 30-pound electronics package designed to transmit ground data to NASA's Random Access Measurement System, which is carried by Nimbus-6. NASA's Goddard Space Flight Center, which receives Nimbus-6 information through an Alaskan ground station as the satellite passes over the North Pole, is conducting the unusual experiment.

The scheduled event features 12 antique cars from six countries competing in a 60-day race that will take them over land and water from Paris to Asia, and thence to the United States. Termination point is New York City. The 1914 Ford that will carry the NASA package will be driven by Robert H. Pickard, project manager of GOES (Geostationary Operational Environmental Satellite) at the Goddard center. Mr. Pickard, who will represent himself (not NASA) in the race, owns and operates the automobile. He rebuilt the car especially for the rally.



U.S. Entry in Worldwide Race—Robert H. Pickard, a space engineer at the Goddard Space Flight Center, inspects the antique Ford automobile he will drive in a Bicentennial round-the-world rally. The car, one of 12 pre-1915 vehicles in the mid-1976 race, will carry special electronics equipment to transmit data to a NASA satellite. Contestants will drive through France, Belgium, West Germany, Austria, Hungary, Yugoslavia, Bulgaria, Turkey, India, Japan and the United States.

Afro-American History Month

NASA Administrator James C. Fletcher made the following statement concerning Afro-American History Month, which was observed during February:

"As we celebrate the 200th anniversary of our nation's birth, it is fitting that we pay particular attention to the contributions black Americans have made since the earliest days of the American revolution. They have defended the principles on which our country was founded in every armed conflict since the Boston Massacre, in which a black man, Crispus Attucks, became the first American to give his life . . . for the new nation.

"In peacetime, black Americans have been farmers, merchants, inventors, scientists, theologians and scholars. They have consistently given of themselves in the best tradition of patriotism."

Dr. Fletcher said that all NASA installations observed the month-long event through audio-visual presentations, lobby displays and guest speakers.

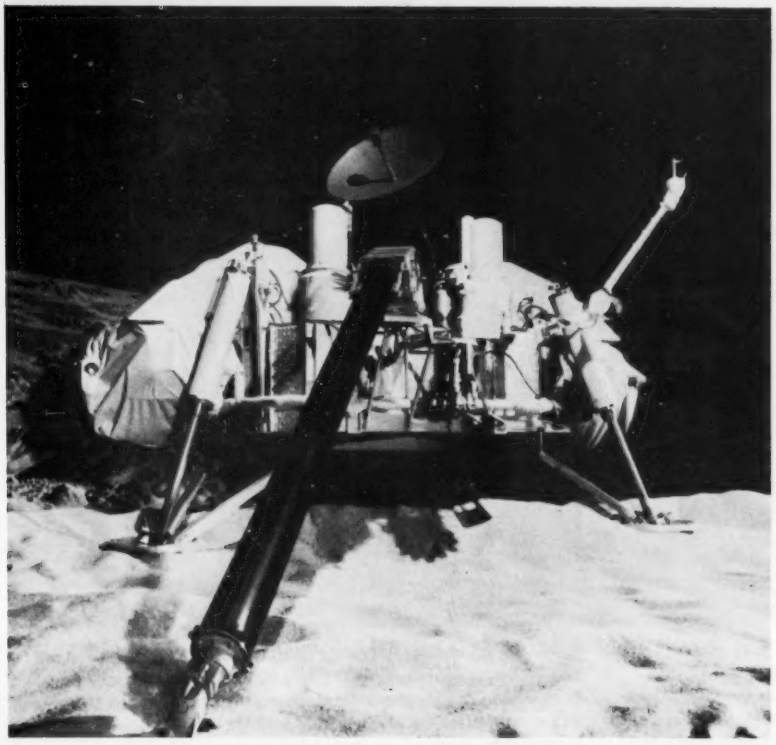
Malfunction Detected in Viking Ovens

Two small ovens, one aboard Viking 1 and one aboard Viking 2, appear not to be working, according to observers of recent checkout tests. Both Vikings are enroute to Mars for the first U.S. attempt to soft-land on that planet.

The ovens, three on each lander, are designed to heat Martian soil samples to 500 degrees C. (932 degrees F.) to release organic constituents in the soil for analysis by a gas chromatograph mass spectrometer. Scientists hope that results of testing by the specially designed device will provide evidence of the existence or non-existence of past or present life forms on the Red Planet.

During the in-flight test of Viking 2, data indicated that one of the three ovens may not function on Mars. Project officials then examined prelaunch test results on Viking 1 ovens and found a similarity in the data related to one oven, leading to suspicion of a second failure. Final judgment will be reserved until tests are run on Martian soil. If the ovens are lost, it means that only two soil samples will be tested aboard each lander, not the three originally planned. But the loss will not significantly affect the experiments.

The two Viking spacecraft, launched in August and September 1975, will reach Mars on June 19 and Aug. 7, 1976. The first lander will be detached from the Viking Orbiter and descend to the surface in early July. Lander 2 will descend in early September. Each lander carries a full complement of identical experiments.



Reconnoitering Mars—This full-sized working model of the Viking Mars lander is on display at the Jet Propulsion Laboratory. The lander is a miniaturized laboratory packed in a hexagonal box 149 centimeters (59 inches) wide by 46 cm. (18 in.) high, weighing about a ton. A soil sampler extends at center. The turret-like structures are cameras.

A House for the Future

An unusual dwelling called the "Tech House" is being built by NASA's Langley Research Center at Hampton, Va. The three-bedroom house, a project of the NASA Technology Utilization Program, features technology developed from aerospace research.

Scheduled for completion in July, the premises will be occupied for one year beginning in early 1977 by an "average family" selected by NASA. As a consequence of the innovative design features incorporated in the Tech House, fuel consumption of the occupying family is expected to drop by about two-thirds (15,000 kilowatt hours compared with an average of 46,000 for a family of four), water consumption by about one-half. All systems will be closely monitored by engineers, and all expenses will be calculated on a day-to-day basis.

NASA program managers believe the structural concept and design may influence home construction. All equipment and features contained in the Tech House are either available now to the public, or will be within five years.

Maximum use has been made of energy-saving ideas and equipment through the inclusion of: 29 square meters (320 square feet) of solar heat collectors, combined with night radiators and a heat pump to produce a most effective heating and cooling system; a waste-water reclamation system that collects water used in sinks, bathtubs and laundry, and recycles it for use as toilet flush water; advanced control systems to precisely regulate heating and cooling, and to be less costly because their integrated circuitry can be mass-produced; plastic foam to provide superior fire-resistant insulation; a flat conductor electrical cable system for greater current carrying capacity and for savings in copper requirements and insulation cost; solid-state appliances; heat pipe systems to recapture waste heat from the water storage tank and from other sources; and battery powered ionization smoke detectors and burglar alarms.

Space Technology for Home Builders—The "Tech House," built at the Langley Research Center, is of contemporary, one-story design. It features a large living room with fireplace, three bedrooms, dining area, kitchen, two baths, laundry, two-car garage and outdoor living area. Total enclosed living space is approximately 1,600 square feet. Estimates by project managers at NASA's Langley Research Center are that the house can be commercially built for $40,000 to $50,000 in the near future, depending on customer preference and construction location. The dwelling, which incorporates technology developed in space programs, will be open to the public for several months in 1976.

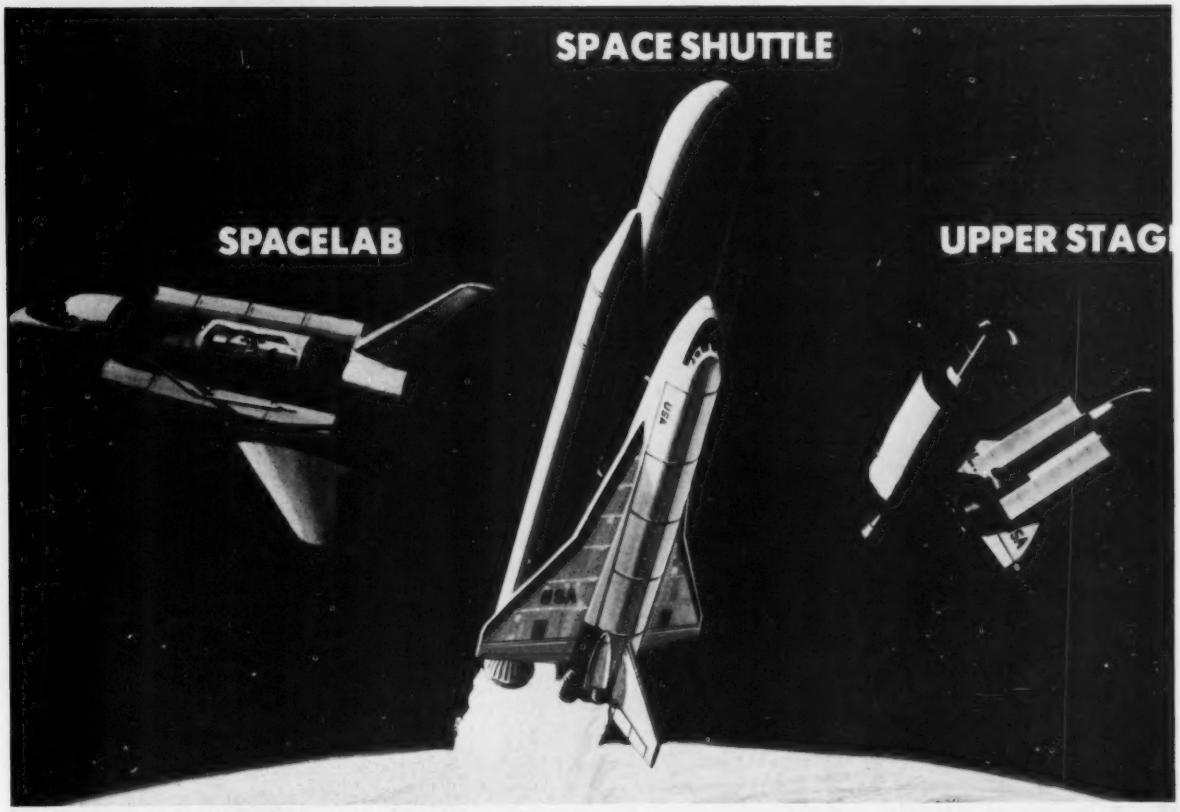
Langley's Research Facilities Engineering Division is directing the Tech House project. Contributors to the project include other NASA field centers, the National Association of Home Builders, the Department of Housing and Urban Development, and the National Bureau of Standards and Technological Economies, Inc. Old Dominion University of Norfolk, Va., and the Hampton Institute of Hampton, Va. also lent assistance. Design of the house was based on engineering studies made by the architectural firms of Forrest Coile and Associates, Newport News, Va., and Charles W. Moore Associates of Connecticut.

MSFC Assigned Two Missions

NASA has assigned project management responsibility for the first two Spacelab experiment payloads to the Marshall Space Flight Center. Spacelabs 1 and 2 currently are scheduled for flight about three months apart on the Space Shuttle in 1980. The Spacelab 1 payload will be a joint NASA and European Space Agency endeavor; Spacelab 2 currently is solely a NASA undertaking.

The Marshall center has prepared a project plan for approval by NASA headquarters, to be followed by an announcement of opportunity that will notify investigators of the scheduled missions and invite them to submit proposals for experiments to be carried aboard Spacelab. The choice of experiments will have a direct bearing on the selection and training of payload specialists who will serve as crew members on the Shuttle.

Program manager for the two Spacelabs is Robert Kennedy of NASA's Spacelab Payloads Office, Solar Terrestrial Division, Office of Space Science. At MSFC, project management responsibility is under the direction of O. C. Jean.



Next Decade's Space System—An artist's rendition of the Space Transportation System, which will be the mainstay of the national space program in the 1980s. Planned to provide easy access to and from space, the system entails the Space Shuttle, the Spacelab—both well into developmental stages—and an Interim Upper Stage. The IUS will be developed by the U.S. Air Force, using solid propellant rockets.

This is the second in a series of profiles of NASA field centers.

NASA Field Installations
Lewis Research Center
Cleveland, Ohio

The major objectives of NASA's Lewis Research Center are research on propulsion for aircraft and spacecraft, management of two medium-weight launch vehicles, power generation systems for terrestrial and space application, and materials, and allied reserch.

The center itself occupies 350 acres adjacent to Cleveland Hopkins International Airport and 8,000 acres at the Plum Brook Station near Sandusky, Ohio, about 50 miles west of Cleveland. The physical plant includes a number of unique major facilities such as altitude chambers, wind tunnels, huge vacuum tanks, a 500-foot-deep chamber for free-fall experiments, as well as laboratories for chemical, metallurgical, physical and electrical research. The total capital investment is about $270 million.

The staff consists of about 3,000 people, including 1,300 scientists and engineers, 1,250 skilled artisans and technicians, and 450 clerical and administrative personnel.

At present, the aeronautics portion of NASA's program emphasizes concern for the environment and for dwindling fuel resources. As the agency's propulsion center, Lewis is carrying out activities that will lead to quieter, cleaner operations for aircraft, and to aircraft that use less petroleum fuel than contemporary jets. In the case of fuel-conservative aircraft, modifications to existing engines, as well as new engine concepts, are being studied. Additional basic studies of engine cycles for supersonic aircraft and of propulsion systems for short-haul planes are being made. Research centered on components, fuels, lubricants and new materials support such programs.

In space research and technology, work is concentrated on advanced propulsion systems such as the one planned for the Space Tug, electric rockets for station-keeping and direct propulsion, and spacecraft technology. A super-efficient traveling wave tube developed at Lewis is being tested in space aboard the Communications Technology Satellite, launched last January. The center also is providing support to a number of other services: a system to help ships navigate the ice-covered Great Lakes, surveys of stripmined land in Ohio and Kentucky, and a concept of a satellite to warn U.S. citizens of natural disasters such as floods or tornados.

Lewis is responsible for the management of the Atlas-Centaur and the Titan-Centaur high-energy launch vehicles that boost the majority of unmanned payloads for NASA, private organizations and other governments. The payloads include communication satellites, scientific probes and planetary spacecraft.

Lewis Research Center Director Bruce T. Lundin (left) is shown with two of his associates at the Cleveland center. Center is Dr. Herman Mark, chief of the Aerospace Applications Branch; and Harold E. Sliney, head of the Lubricant Section.

Additional projects relate to solar collectors, solar cells, wind turbines and other promising methods of energy production designed to assist the nation toward solutions to energy problems.

Lewis Director Dr. Bruce T. Lundin has been associated with LeRC in various capacities since 1943, when the center was a part of the National Advisory Committee for Aeronautics, NASA's predecessor. An engineer and an expert on turbojet engines, Lundin transferred from the center to Washington headquarters in 1968 to become Deputy Associate Administrator for Advanced Research and Technology. He was appointed Director of LeRC in 1969. Lundin is assisted by Deputy Director Dr. Bernard Lubarsky.

"Optimistic" is probably the most fitting word for Lundin's 1976 attitude, which he expressed recently in his annual "State of the Center" message to his staff.

"The state of health of the center is very good," Lundin said. "Our budgets continue to grow, our many programs of work have been successful, we will enjoy a stability of staffing levels for the coming year, both new facilities and the rehabilitation of older ones are progressing nicely, and we enjoy good relationships with all those with whom we work.

"Perhaps the most outstanding accomplishment of our center last year, at least from the standpoint of national significance and visibility, was the successful launch of the two Viking spacecraft last summer. Our new Titan/Centaur rocket performed flawlessly and was handled in an extremely competent and professional manner. And after completing our part of this billion-dollar mission, we went on a few days later to launch another Atlas/Centaur carrying an Intelsat communications satellite—altogether three major launches in 37 days. It was a very busy time.

"Then, to cap off the year, Titan/Centaur in January sent the German spacecraft, Helios, toward the Sun with the highest energy ever imparted to a spacecraft, in a nearly perfect trajectory. With four straight successes, this powerful and complicated five-stage rocket has now proven itself to be a very versatile, reliable and cost-effective launch vehicle in our nation's space capability.

"After sending Helios on its way, Centaur went on to a total mission of more than nine hours, all the while keeping track of itself, controlling its pressure, temperatures and orientation, and starting up and shutting down its engines in an orderly fashion a total of seven times. If we ever need a hydrogen-fueled upper stage for the Shuttle, as I believe we will, 80 percent of it is already there in Centaur."

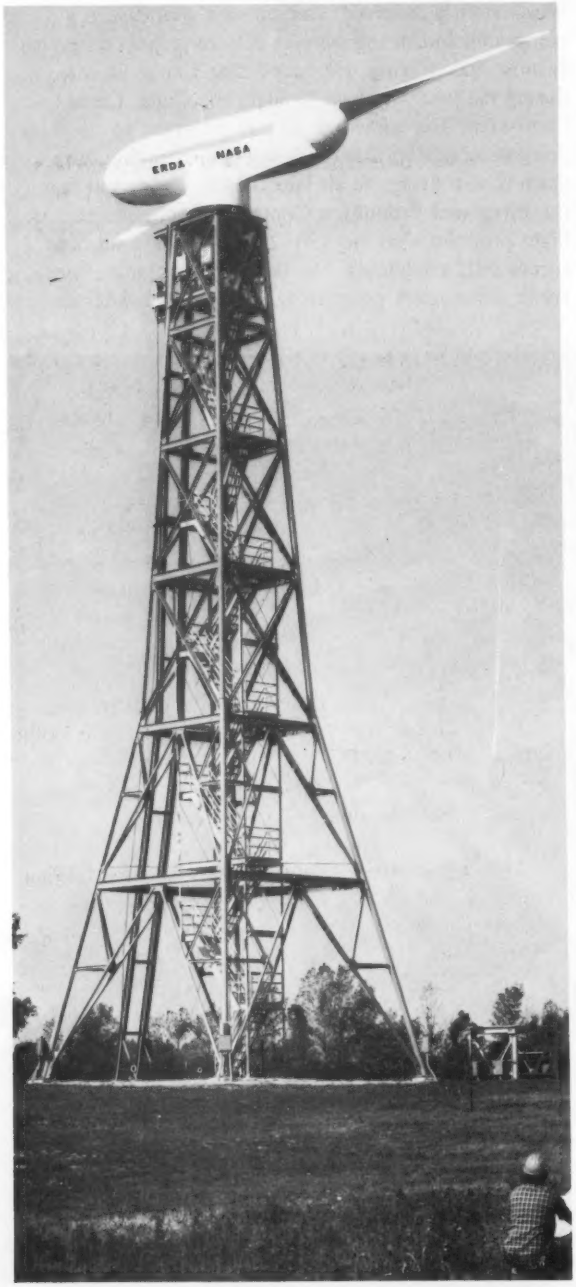
Turning his attention to space flight programs, Lundin emphasized the importance of the Communications Technology Satellite, stating that he remains convinced that space communications has a rich future and that the Lewis center has an important role in that field.

"This new spacecraft is now in orbit and doing fine," he said. "All the difficult technical challenges we faced a year ago have been overcome, all the complex testing and qualifications of the spacecraft were highly successful, and we are now ready for a series of exciting and important user experiments that will bring educational, medical, cultural and social services to people in remote areas of Canada and the United States."

Concerning aeronautics, in which about half the Lewis staff is involved, Lundin said that NASA's continuing and strong support of aeronautical programs is most encouraging. He added that Lewis' efforts during the past year have brought the Quiet, Clean, Short-Haul Experimental Engine program to its mid-point successfully; that the Global Air Sampling Program is now flying the air lanes of the world; and that the Integrated Propulsion Control System and the flight program with the YF-12 airplane have all been successfully completed. "In fact," said Lundin, "our entire auronautics program is thriving. Our R&D budget

The Lewis Research Center occupies some 350 acres of land, about 15 of which are leased from the city of Cleveland for the conduct of research on advanced propulsion systems or power-generating systems. Part of the airfield is seen in upper part of photo, with flight research building (hangar-shaped), and engineering service and utilities buildings alongside. Round, white structure in foreground is a helium gas holder. Building in foreground, with rows of fans on roof, is the propulsion systems laboratory's cooling tower. Various other structures are for chemistry, administration, metallurgy, plasma physics, heat transfer, electronics, control dynamics and other areas pertinent to propulsion and power-generation systems.

World's Largest Wind Turbine—This new wind energy conversion system, the biggest built in the United States since the 1940s, is situated at NASA's Plum Brook station—a part of the Lewis Research Center—in Sandusky, Ohio. The 100-kilowatt turbine is mounted on a tower that stands 100 feet high. The rotor contains two aluminum blades that rotate to a speed of 40 rpm. The machine is designed to provide engineering data for use as a base for the entire wind energy program, which is carried out by the Energy Research and Development Administration.



for next fiscal year will be 18 percent higher than that of the present year—or at about the same rate it has grown each year."

Lundin spoke of the relationship between NASA and the Energy Research and Development Administration, as he made reference to the significance of the dedication of the Wind Turbo-Generator Facility at Plum Brook last October. "Surely the most visible event here was the dedication of this new national facility, he said. "To have brought it into being from design to operation in 18 months was truly a magnificent achievement. But that is not all in the confusing and burgeoning field of energy R&D. Another study—a major analysis of various ways to convert coal to electricity—is nearing completion and will serve to identify both what our nation's major thrust should be in the technology of the future and to place Lewis in the mainstream of those involved with the future of our nation's energy supplies."

Turning to the NASA Budget for FY 1977, Lundin said he was pleased with the increase from 3.5 billion dollars to nearly 3.7 billion. "Of particular significance to us was one of the areas of budget growth," he said. "Our aeronautics budget is up nearly 20 percent and our space technology budget some eight percent over last year. So, while the total budget is up some four percent, our part of it has been increased more than that."

On the subject of personnel, Lundin said: "Next year will see a reduction in personnel at all the centers and headquarters except for three installations—the Kennedy and Johnson centers because of the growing demands of the Shuttle, and here at Lewis because the work is not duplicated elsewhere, and because of our growing programs in aeronautics and energy R&D.

"With a constant employment level of 3,025 civil service personnel now allotted to us, we will be able to maintain our normal attrition rate of about 80 or 90 individuals a year. Though not a large number, it does enable us to bring in some four or five times as many new employees as we have had in previous years. So I look forward to acquiring some of the youthful people we need so much, and to correcting some imbalances in our staffing levels." Lundin also said that efforts must be increased to meet all goals of EEO programs.

Lundin's message to his staff closed with expressions of pleasure and pride in the Lewis staff, and with the statement that he was grateful to be director of "a great center in those exciting times."

Did You Know?

NASA has awarded a letter contract to the Singer Company, Simulation Products Division, Binghamton, N.Y. for development of a Shuttle mission simulator for use as a trainer for the Space Shuttle Orbiter vehicle crew and flight controllers. The simulator is to be delivered to the Johnson Space Center in March 1978 for use as a training station for Shuttle orbital flight tests 1 and 2; modifications to the vehicle required to train crews for orbital flight tests 3 and others will be delivered and installed by March 1979. The simulator will be used to train crews and flight controllers in all Orbiter mission phases—launch, orbital insertion, orbital operations, re-entry and landing.

Estimated cost of the program is $28,600,900. The work will be managed by the Johnson Space Center.

Attendance on the NASA-Marshall Space Flight Center bus tours set a record in 1975, causing officials to predict an increase, possibly to 100,000 tourists, during the Bicentennial Year. Total attendance last year reached 85,897, a 22 percent increase over 1974. The non-profit bus tours are operated as a cooperative project of MSFC and the Alabama Space and Rocket Center in Huntsville. MSFC provides the stops, including videotape presentations, and ASRC sells tickets and operates the buses.

The country of Laos was the unusual setting for an extensive exhibition of American space activities in late 1975.

The major exhibit themes at the American Pavilion, one of the attractions at the Luang Fair at Vientiane, were space exploration and the American Bicentennial. The 15-day event is a yearly celebration in which about 12 foreign countries generally participate, displaying commercial products, national artifacts, and illustrations of their history and culture. Some 75,000 people, mostly Laotians, visited the U.S. pavilion and saw exhibits centered on the Apollo-Soyuz project, Skylab, space vehicle models, the spacesuit, and public benefits derived from space research. Much in demand among visitors were Lao language copies of the NASA publication, "Apollo Moon Landings."

The Goddard Space Flight Center exceeded its Combined Federal Campaign goal for the fourth consecutive year in 1975. The center contributed $167,047 to CFC national agencies, plus $13,389 to the CFC of central Maryland. The GSFC goal was $165,000. Center director John F. Clark chaired the successful campaign.

The Kennedy Space Center led all NASA centers in energy conservation through December of the current fiscal year, achieving a 33-percent total savings in energy consumption. The saving is based on FY-73 usage, the baseline established by Presidential order for measuring energy savings. The NASA-wide goal is 17 percent below FY-73 usage. KSC figures show a saving in electricity of 41 million kilowatt hours and of 417,000 gallons of fuel oil for heating.

More than 150 industrial and academic researchers met in mid-March at the Johnson Space Center to examine potentials of processing biological materials in space flight. The meeting, called "Colloquium on Bioprocessing in Space," was held to acquaint researchers in the pharmaceutical, biomedical and biological fields with opportunities that will be available to them aboard Spacelab in the 1980s. Space processing experiments flown in Apollo, Skylab and Apollo-Soyuz flights revealed that many substances exhibit unique characteristics in the weightlessness of space flight.

The NASA Voice Teleconference Network, which operates under the direction of the Marshall Space Flight Center, is saving impressive amounts of travel money and time for the agency. In November and December 1975, NASA held 255 teleconferences, in which 1,235 civil servants and contractors took part. Estimates are that the practice saved the travel expenses of more than 500 people during the two-month period.

The system originated in Project Apollo, in the Saturn Program office at MSFC. Bell System engineers developed the network in conjunction with the MSFC communications division.

NASA has awarded a $6.8 million, two-year contract extension to the Charles Stark Draper Laboratories of Cambridge, Mass., for the technical support of Space Shuttle Orbiter avionics software development. The company will provide computer programming relative to the integration of the guidance, navigation and control systems of the Orbiter, employing 55 people in the effort. The Draper labs have been furnishing similar support to the Johnson Space Center since 1974.

Northrop Services, Inc., of Houston, Texas, has been awarded a $8.8 million, one-year contract extension by NASA for operations and maintenance of laboratory and test facilities at the Johnson Space Center. The extension increases the estimated value of the contract, in existence since 1973, to $13,146,742. ■ ■ ■ ■ ■

Veteran Astronaut Retires

Apollo astronaut Stuart A. Roosa retired from the Air Force and resigned from NASA last January 31, after a 10-year tour of duty. Roosa, a 42-year-old colonel with 22 years of military service, did not reveal his plans for the future.

As command module pilot on Apollo 14 in 1971, Roosa conducted the first extensive lunar orbital science activities during the 33 hours in which his fellow crewmen—Alan B. Shepard, Jr. and Edgar D. Mitchell—were on the Moon's surface. He logged 216 hours and 32 minutes of space flight.

Roosa served as backup command module pilot for the Apollo 16 and 17 missions; his last assignment for NASA was with the Space Shuttle program. Roosa's retirement reduces the number of astronauts assigned to the Johnson Space Center to 28.

Reorganization at KSC

Kennedy Space Center Director Lee R. Scherer recently announced a realignment of the center staff structure in preparation for Space Shuttle operations. Eliminated was the Installation Support Directorate.

Dr. Walter J. Kapryan, since 1969 director of Launch Operations, was named director of Space Vehicle Operations in a move to restructure the Apollo/Saturn launch organization for Space Shuttle work. John J. Williams, director of Spacecraft Operations since 1964, was named Kapryan's deputy.

Reporting to Kapryan will be Paul C. Donnelly, director for Space Transportation System Processing; George T. Sasseen, director for Shuttle Engineering; and Isom A. Rigell, director for Shuttle Payloads.

George F. Page has been designated director, Expendable Vehicles. Joseph F. Malaga becomes director of Administration and Management Operations.

Named as director, Administrative Operations and Support Services was Robert G. Long, formerly chief, Center Resources Planning and Control. John R. Atkins was named director of Safety, Reliability, Quality Assurance and Protective Services. Peter A. Minderman is director of the Technical Support Directorate, with John J. Neilon as his deputy director. John P. Claybourne was appointed manager of the Sciences, Technology and Applications Office. Wm. M. Lohse is director, Procurement Supply and Transportation.

Anglers Look to Satellites as Potential Fish Finders

A recent seminar held at NASA's National Space Technology Laboratories, Bay St. Louis, Miss., addressed

GSFC Award to MSFC Man— Gilbert W. Ousley (left), manager of the U.S. Helios project at the Goddard Space Flight Center, presents a certificate for a Helios team NASA Group Achievement Award to Rein Ise of the Marshall Space Flight Center.

itself to the consideration of space technology as an aid to sportfishermen.

In attendance were saltwater fishermen, sport commentators and outdoor writers, as well as spokesmen from NASA's Earth Resources Laboratory of the Johnson Space Center, the National Marine Fisheries Service, the National Fish and Wildlife Service, Geological Survey, and the Fisheries Engineering Laboratory of Mississippi State University. The seminar was sponsored by the Mississippi Office of Science and Technology, one of NSTL's tenants. Guests were given a conducted tour of the NASA center.

Discussions at the one-day seminar centered on what benefits sportfishermen in the Gulf and southeastern Atlantic area might realize from space technology; whether spacecraft and aircraft imagery could reveal likely fish-producing areas; and whether it might be possible to set up a fish probability forecasting service for sportsmen.

1976 National Award Competition for Space Essays

The National Space Club recently announced the opening of the Robert H. Goddard Historical Essay Award competition for 1976. Essays may deal with any significant aspects of the historical development of rocketry and astronautics and will be judged on their originality and scholarship. The contest is open to any U.S. citizen. The winner will receive the Goddard Historical Essay Trophy, an NSC certificate and a $500 honorarium.

Members of the space club's Committee for the History of Rocketry and Astronautics serve as judges. The contest is named in honor of the rocket pioneer, Dr. Robert H. Goddard, whose many scientific and technological contributions to rocketry development helped pave the way for the major breakthroughs of the national space program.

Additional information may be obtained from the Goddard Historical Essay Contest, c/o National Space Club, 1629 K St., N.W., Washington, D.C. 20006.

Most NASA Launches this Year for Paying Customers

Three-quarters of the 19 spacecraft launches planned by NASA for calendar year 1976 will be for cash customers. The sponsors of 15 scheduled launches of satellites or space probes include: NATO, the Republic of Indonesia, the International Telecommunications Organization, Comsat General Corp., RCA, NOAA, and the Department of Defense. Last year the agency launched 21 spacecraft, of which nine were reimbursable. (Two failed to achieve orbit.)

"The growth of the reimbursable launch activity is a true indication of the maturity of the space program," said Joseph B. Mahon, NASA's Director of Expendable Launch Vehicles. "When commercial firms and other outside-NASA organizations account for more than two-thirds of NASA launches, and pay for them, th age of space exploitation is really here."

So far in 1976, five launches have taken place, consisting of Helios-B, CTS, Intelsat IV-A-B, Marisat and RCA-B, with 14 to follow.

Safe Clothing for Firefighters— Edward Z. Grey (left), NASA assistant administrator for Industry Affairs and Technology Utilization, signs an agreement with the National Fire Prevention and Control Administration of the Department of Commerce. The agreement is for a three-year cooperative program to develop better and safer clothing and equipment for the nation's firefighters. Participating also in the signing ceremony recently held in Washington, D.C. was Dr. Joseph E. Clark, associate administrator of Commerce's NFPCA. The program, jointly funded in the amount of $300,000 for the first year, will be managed by the NASA Marshall Space Flight Center. Emphasis will be placed on adapting safety methods developed by NASA for manned space flight to effective use by firefighters on Earth.

Contract to Study Quiet Aircraft Awarded

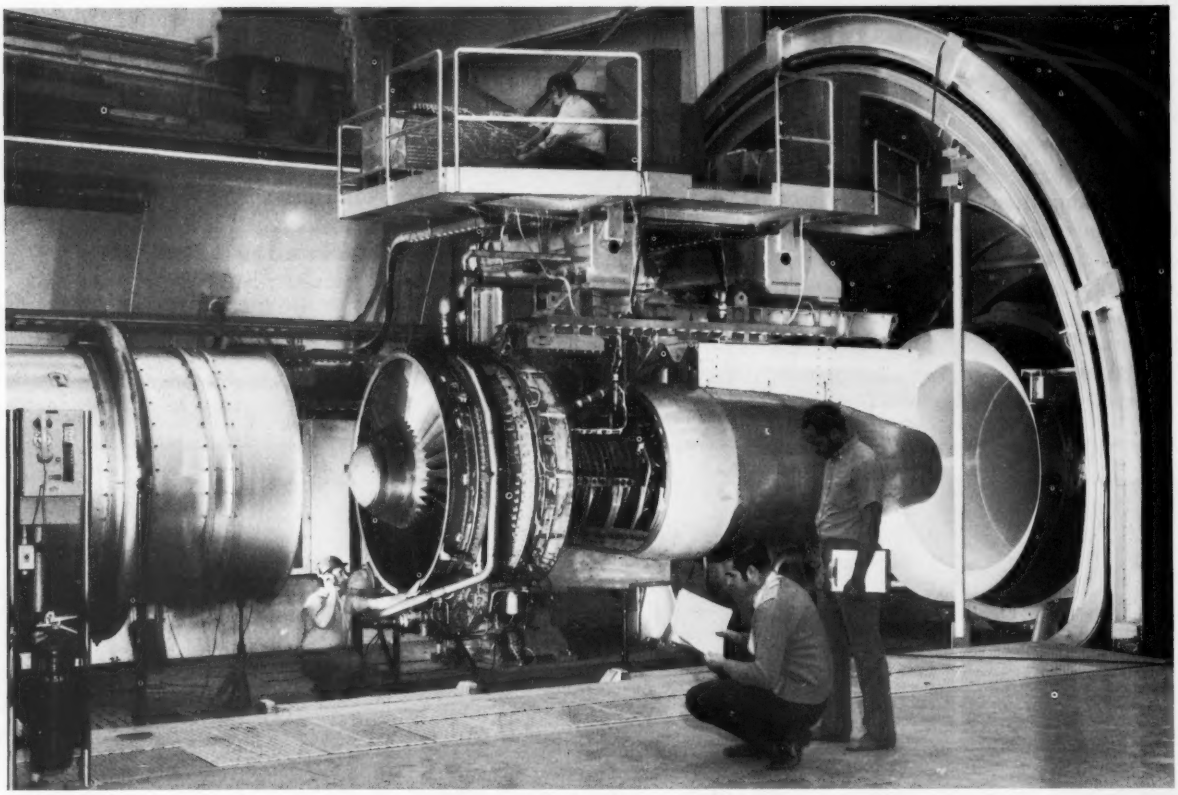
A cost-plus-award-fee contract of about $20 million was recently awarded by NASA to the Boeing Commercial Airplane Co., Seattle, Wash., to build an experimental flight research aircraft aimed at developing technology to reduce aircraft noise impact on U.S. communities. Reduction of congestion at major airports is a second consideration.

Boeing will modify a government-furnished deHavilland C-8 Buffalo transport plane into a quiet, short-haul research craft to be used used in a research program at NASA's Ames Research Center. The government also is furnishing four AVCO-Lycoming YF-102 turbofan engines for the plane.

Today, short-haul air trips (less than 600 miles) account for about half of all U.S. air travel demands. A need exists to reduce the noise impact, airport congestion and fuel requirements associated with the short-trip craft.

A possible solution to these problems could be the application of NASA-developed, quiet technology to civil transport aircraft to achieve a short takeoff and landing capability. Aircraft incorporating such technology could then use the short (600- to 1,200-meter or 2,000- to 4,000-foot) runways at existing smaller airports and at landing areas built especially for the new planes. Traffic congestion thus could be relieved at larger airports.

The aircraft under study also could operate safely at low speeds, which permit not only the use of much shorter airport runways, but steeper approach and takeoff angles to avoid heavily populated communities.



Seeking Silence—Tests of the world's quietest jet engine were conducted in the Lewis center's Propulsion Systems laboratory. In the test program, the engine was operated in a chamber under altitude conditions between 25,000 and 50,000 feet and at air speeds up to Mach .95. Performance and fan stall margin were measured for the engine with a bell mouth inlet and an acoustically treated, sound-dampening inlet.

Center Director Is Honored

Clark

Dr. John F. Clark, Director of the Goddard Space Flight Center, recently was elected a Fellow of the Institute of Electrical and Electronics Engineers, Inc. The singular honor—given to only two percent of the institute's 175,000 membership—is reserved for individuals who have shown evidence of outstanding and extraordinary qualifications and experience in the field of electrical and electronics engineering. Dr. Clark was awarded the fellowship "for technical leadership of space programs."

Newly elected Fellows of the IEEE will be recognized at the organization's annual banquet to be held in May in Boston, Mass.

Radio-Television

(*Released nationally*)

TELEVISION: A 4½-minute and a 90-second film have been released in the Aeronautics and Space Report monthly series. They feature the voice-activated wheelchair and are entitled "Space Technology Aids Handicapped."

RADIO: Four weekly *Space Story* programs have been released —"Viking-Mars Weather Watchers" (Dr. Seymour Hess); "Spacelab" (MSFC/Jack Lee); "Viking Seismic Experiment" (U. of Texas/Dr. Gary Latham); and "Viking Biology Search" (Biospherics/Dr. Gilbert Levin). One monthly *NASA Special Report*, "Images from Viking: A Picture Preview of Mars" (Harold Masursky and Dr. Thomas Mutch). One set of ten 60-second announcements on Viking, *NASA Space Notes*.

Lunar Sample Exhibits

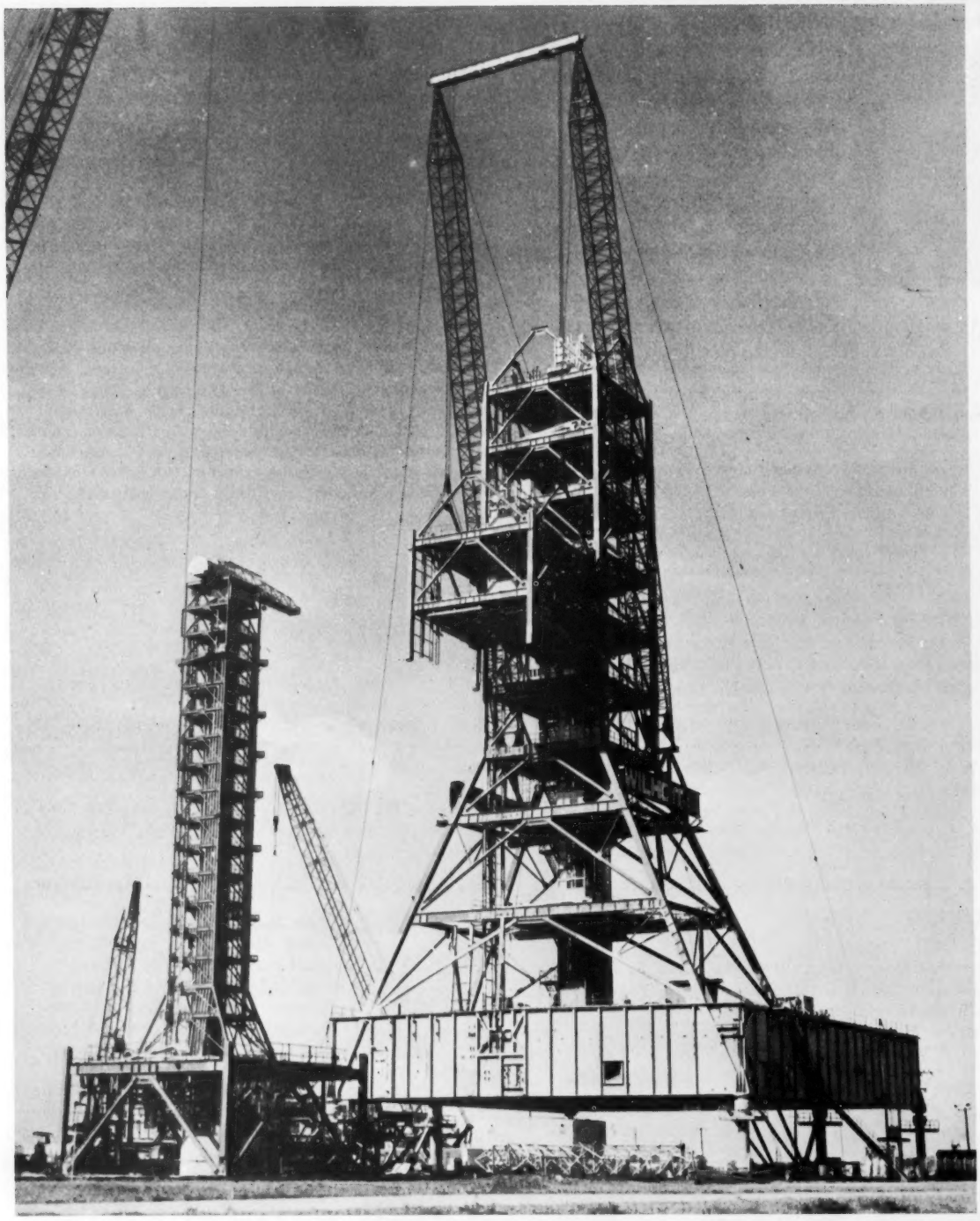
The following is a schedule of lunar sample exhibits from mid-March to mid-April:

Idaho—Wallace High School, Wallace, March 11-12.
Louisiana—Bicentennial Festival, Lake Charles, April 9.
Massachusetts—Goddard 50th Anniversary, Auburn, March 16.
Pennsylvania—University of Pittsburgh, Bicentennial Space Program, Pittsburgh, April 5-7.
Wisconsin—Wisconsin Bicentennial Exposition and Conference, Milwaukee, March 25-27.
American Freedom Train—Wichita, Kan., March 16, Kansas City, March 22; St. Louis, Mo., March 30; Little Rock, Ark., April 13.
High Flight Foundation Bicentennial Mobile Space Museum—West Frankfort, Ill., March 16-21; Mt. Morris, Mich. April 6-11.
Tennessee Valley Association-Bicentennial Caravan—(Ga.) Savannah, March 13-16; Sylvania, March 17; Augusta, March 18-19; Washington, March 20. (S.C.) Greenville, March 21-22; Spartanburg, March 23. (N.C.) Hendersonville, March 24; Brevard, March 25-26; Franklin, March 27; Cherokee, March 28-29; Asheville, March 30-31; Newton, April 1-2; Asheboro, April 3-5; Laurinburg, April 6-7; Sanford, April 8-9; Goldsboro, April 10-12; Trenton, April 13; New Bern, April 14-15.

Long-term Displays

Alabama—Ala. Space & Rocket Museum, Marshall Space Flight Center, Huntsville.
Florida—Visitor Information Center, Kennedy Space Center.
Kansas—Eisenhower Library, 200 SE 4th St., Abilene.
Mississippi—The National Space Technology Laboratories, Bay St. Louis.
New York—United Nations Building, New York City.
Ohio—USAF Museum, Wright Patterson AFB.
Texas—Johnson Library, University of Texas, Austin; Visitor Information Center, Johnson Space Center, Houston.
Virginia—Visitor Information Center, Langley Research Center, Hampton.
Washington, D.C.—National Geographic Museum; Smithsonian Institution, National Air and Space Museum; Washington National Cathedral.

Many Happy Returns to a Distinguished NASA Alumnus—Dr. Smith J. DeFrance celebrated his 80th birthday last January 19, with the help of 1,100 Ames Research Center employees. DeFrance, director of the Ames center for its first 25 years, is flanked by (left) Dr. Hans Mark, Ames director, and H. Julian Allen, former Ames director, as they presented a commemorative plaque to the man who was responsible for designing and building the center. The shadowbox plaque—designed by Darryll Stroud of the Ames graphics and exhibits branch—shows the interior of the 40- by 80-foot wind tunnel now under construction. DeFrance's work at Ames earned him the Presidential Medal of Merit, as well as the 1964 Career Service Award of the National Civil Service League.



Apollo Launcher to Be Used for Space Shuttle—The Kennedy Space Center's mobile launcher 3 (foreground) is undergoing modification for Space Shuttle launch operations. The launcher's 380-foot umbilical tower—used for final launch preparations and entry for the astronauts during Apollo flights 10, 13, 15, 16 and 17—was dismantled in sections, to be reassembled as a Shuttle service and access tower at Pad A, the first of two being modified for Shuttle launch operations. The launch platform is undergoing redesign to serve as a mobile launcher platform on which Space Shuttle vehicles will be assembled in the Vehicle Assembly Building and transported to the pad for launch. In the background is another umbilical tower that also will be modified for new usage at some future date.

All Dressed Up—Sporting fancy new paint jobs, two GSA buses and a sedan that operate at the Kennedy Space Center are decorated in honor of the Bicentennial Year. The buses' license plates bear the numbers 1976 and 1776. The three vehicles are used for special tours of the center.

New NASA Publications

Questions about Aeronautics and Space compiles brief answers to questions often asked in thousands of letters to NASA each year. Among the provocative questions answered are:

- Why not use some of the money spent on space to solve social problems such as hunger, poverty, ill health and pollution?
- Will we ever have women astronauts?
- What is Spacelab?
- What benefits have we received from the space program?
- Why isn't there more international cooperation in space projects?
- Is NASA working on aircraft fuel economy?

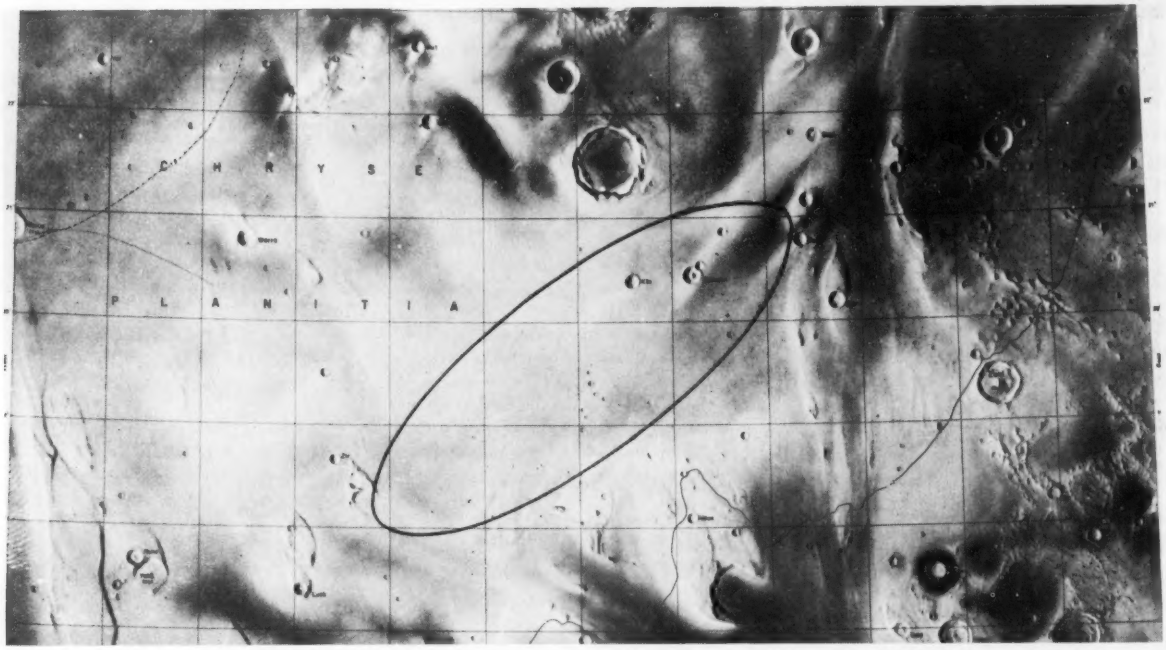
The pamphlet is available agencywide from educational and public information offices.

Patents for Inventions from NASA Research

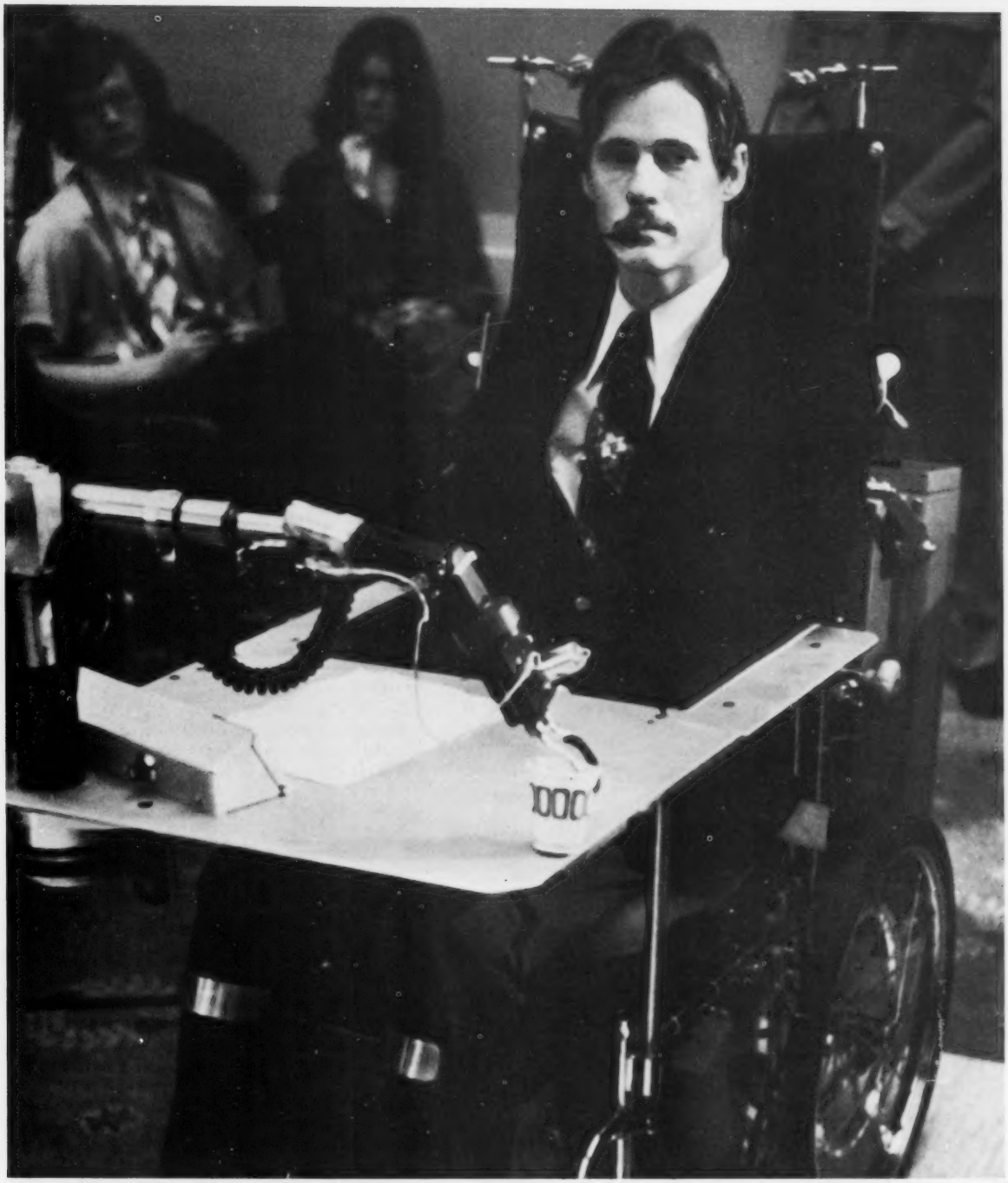
The Office of General Counsel, NASA Headquarters, announces that the following U.S. patents have been issued by the U.S. Patent Office to NASA for inventions resulting from NASA research. Inquiries concerning them should be directed to the attention of the NASA Patent Counsel for the indicated installation.

Inventor(s) and Employer(s)	Title and NASA Docket	Patent No.	Installation
Robert R. Belew, NASA/MSFC Donald E. Davis, Rockwell Intl. Corp., Hopedale, Mass.	Optical Pantograph (MFS-22,808-1)	3,936,942	MSFC
Robert L. Kurtz, NASA/MSFC	A Holographic Motion Picture Camera (MFS-22,517-1)	3,937,555	MSFC
Michael W. Fitzmaurice, NASA/GSFC Mona Tycz, NASA/GSFC	Apparatus for Simulating Optical Transmission Links (GSC-11,877-1)	3,937,945	GSFC
William P. Gilbreath, NASA/ARC Michael J. Adamson, NASA/ARC Alex Fassbender, Foothill College, Los Altos Hills, Calif.	Electrical Conductivity Cell and Method for Fabricating the Same (ARC-10,810-1)	3,938,035	ARC
Robert T. McKenna, GSFC/NASA	Automatic Character SK W and Spacing Checking Network (GSC-11,925-1)	3,938,182	GSFC
Charles H. Lucas, Caltech/JPL, Pasadena, Calif.	Analog to Digital Converter (NPO-13,385-1)	3,938,188	NaPO
Vincent P. Caruso, NASA/MSFC Elbert J. Minter, NASA/MSFC	Method of Peening and Portable Peening Gun (MFS-23,047-1)	3,937,055	MSFC
K. P. O'Kelly, A. B. Featherston } LTV Aerospace Corp Missiles and Space Div., Dallas, Texas	Method of Fluxless Brazing and Diffusion Bonding of Aluminum Containing Components (MSC-14,435-1)	3,937,387	JSC
Richard F. Schmidt, NASA/GSFC	Variable Beamwidth Antenna (GSC-11,862-1)	3,938,162	GSFC
Dan Padilla, Martin Marietta Corp., Denver, Colo.	Method and Apparatus for Fluffing, Separating, and Cleaning Fibers (LAR-11,224-1)	3,937,661	LaRC
Leo J. Veillette, NASA/GSFC	Axially and Radially Controllable Magnetic Bearing (GSC-11,551-1)	3,937,533	GSFC
William C. Schneider, NASA/JSC	Auger Attachment Method for Insulation (MSC-12,615-1)	3,936,927	JSC

Cyril Feldstein, Jules V. Osher, Gilbert W. Lewis, Robert H. Silver, Edward N. Duran	Caltech/JPL	Miniature Muscle Displacement Transducer (NPO-13,519-1)	3,937,212	NaPO
Wayman N. Clotfelter, NASA/MSFC		Apparatus for Measuring the Ferrite Content of Austenitic Stainless Steel Weld Material (MFS-22,907-1)	3,938,037	MSFC
Benjamin F. Bankston, NASA/MSFC				
Donald E. Barthlome, NASA/LaRC		Therapeutic Hand Exerciser (LAR-11,667-1)	3,937,215	LaRC
Charles G. Miller, James B. Stephens	Caltech/JPL	Sampler of Gas Borne Particles (NPO-13,396-1)	3,938,367	NaPO
Charles Elachi, Caltech/JPL		Diffused Waveguiding Capillary Tube with Distributed Feedback for a Gas Laser (NPO-13,544-1)	3,939,439	NaPO
Blake W. Corson, Jr., NASA/LaRC		Cascade Plug Nozzle (LAR-11,674-1)	3,938,742	LaRC
Warren H. Philipp, NASA/LeRC; Stanley J. Marsik; Charles E. May		Process for Making Anhydrous Metal Halides (LEW-11,860-1)	3,939,048	LeRC
John Dimeff, NASA/ARC		Modulated Hydrogen Ion Flame Detector (ARC-10,322-1)	3,938,956	ARC
Orval W. Wade, Martin Marietta Corp., Aerospace Div., Denver, Colo.		Method and Apparatus for Tensile Testing of Metal Foil (LAR-10,208-1)	3,938,373	LaRC
Patrick N. Espy, NASA/MSFC		Gas Filled Coaxial Accelerator with Compression Coil (MFS-22,799-1)	3,939,816	MSFC
John C. Wilson, NASA/LaRC; Craig S. Shaw, NASA/LaRC		Exhaust Flow Deflector (LAR-11,570-1)	3,940,097	LaRC
Larry R. Eaton, McDonnel Douglas Astronautics Co., Huntington Beach, Calif.		Heat Transfer Device (MFS-22,938-1)	3,940,621	MSFC
Edwin E. Klingman III, NASA/MSFC		Electronic Optical Transfer Function Analyzer (MFS-21,672-1)	3,938,892	MSFC



Martian Runway—The ellipse indicates the planned primary landing site for Viking Lander 1 when it touches down on Mars in the summer of 1976 to begin a detailed scientific examination of the planet, including a search for life. The site is in the Martian region called Chryse, at the mouth of a 5,000-mile-deep canyon. The target ellipse is approximately 300×80 kilometers (180×48 miles). The target coordinates are 19.5 degrees North and 34 degrees West. The photograph is of a 1:1,000,000 scale topographic map.



Wheelchair Responds to Voice Commands—Michael Condon, a quadraplegic, demonstrates the voice controlled wheelchair with its mechanical arm (see NASA Activities, June 1975), developed in a cooperative effort by NASA and the Veterans Administration. The chair, being demonstrated here before the House Committee on Science and Technology, is adapted from teleoperator and robot technology developed for the space program. The operator wears a microphone to give 35 different one-word commands which control movement of the chair and the arm. The arm can be extended from one to four feet to pick up objects with its pincer fingers. The voice-command analyzer is a mini-computer built into the wheelchair. Clinical testing is under the direction of the VA Prosthetics Center, New York City; the NASA part of the program is conducted at the Jet Propulsion Laboratory.

Projected Launch Schedule

(As of February 1976)

Name	Launch Date	Vehicle	Range	Mission Remarks
NATO-IIIA	April 22	Delta	ETR	Communications satellite in synchronous orbit to perform communications relay for NATO. Backup to RCA-B.
LAGEOS-A	May	Delta	WTR	Demonstrate relevant space techniques that will contribute to the development and validation of predictive models for earthquake hazard alleviation, ocean surface conditions and ocean circulation.
Air Force Test	May	Scout	WTR	USAF Scientific Payload, reimbursable.
Comstar-A	May	Atlas-Centaur	ETR	Second domestic communications satellite for Comsat. Reimbursable.
Marisat-B	May 27	Delta	ETR	Third Comsat satellite to provide maritime satellite communications services. Reimbursable.
Relativity	May 28	Scout	WI	Scientific probe to make a test of the Einstein's Theory.
Air Force	May	Scout	WTR	USAF scientific payload. Reimbursable.
Navy Transit	June	Scout	WTR	Navy navigation satellite. Reimbursable.
Indonesia-A (Palapa)	July	Delta	ETR	Indonesian communications satellite. Reimbursable.
NATO IIIB	August	Delta	ETR	Communications satellite in synchronous orbit to perform communications relay for NATO. Reimbursable.
Comstar-B	August	Atlas-Centaur	ETR	Second domestic communications satellite for Comsat. Reimbursable.
ITOS-E2	September	Delta	ETR	Operational meteorological satellite of the National Weather Service to provide day and night cloud-cover imagery. Reimbursable.
RCA-C	October	Delta	ETR	Third domestic communications satellite for RCA. Reimbursable.
Marisat-C	December	Delta	ETR	Third Comsat satellite to provide maritime satellite communications services. Reimbursable.
Intelsat-IVA-C	December	Atlas-Centaur	ETR	Third of a series of improved Intelsat satellites. Reimbursable.

Super Secretaries—"Secretary of the Year" was the title bestowed on Billie DeGlopper (center), a secretary in the Marshall Space Flight Center office of the associate director. The award was given by the MSFC-Redstone (Ala.) chapter of the National Secretaries Association, an international organization. Two other MSFC secretaries were runners-up—Linda Phillips (left) of the Shuttle Projects Office, and Eloise Meyer, who works in the same office as DeGlopper.

Superfiend—The legendary "Great Galactic Ghoul" is said to lurk near the orbit of Mars at a point about 35 million miles from Earth and 130 million miles from the Sun, seizing any satellite hapless enough to enter its lair. So far the Ghoul is alleged to be responsible for three space failures and four near misses, including the Soviet Zond 2 and Mars 1, whose radios were lost in the creature's five-million-mile domain. One NASA Mariner satellite lost, then regained, its radio; another experienced so much cosmic dust that it lost some of its instruments; two others lost their guiding stars upon reaching the region, then regained them when they departed; and a battery on Mariner 7 exploded while in the Ghoul's orbit, causing irreparable damage to the spacecraft. More recently, spacewatchers have been worrying about whether the Viking flights can escape attack by the grabby space freak. The creature, a figment of the combined imaginations of John Casani of NASA's Jet Propulsion Laboratory and California newsman Donald Neff, now is routinely blamed for space accidents that happen to Mars-bound craft. How else to explain why all the accidents take place at the same spot, ask JPL observers. They say they have detected no special features or characteristics that might otherwise explain the mystery. Artist G. W. Burton sees the Galactic Ghoul as green and orange in this concept.

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A Rescue of School Books through Use of NASA Equipment

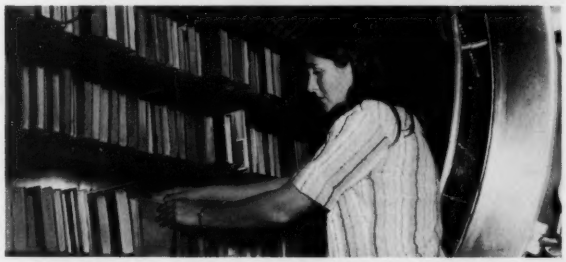
In the aftermath of a severe fire that ravaged the Atlantic High School at Oak Hall, Va., hundreds of library books were found to be watersoaked, some 1,700 of them showing signs of damage by mildew. Librarian Linda Parker appealed to the nearby Wallops Flight Center, asking that the books be stored temporarily in a large, seldom-used building at the NASA center, where the growth of mildew would be deterred by a lack of heat. School officials planned to try to rescue at least some of the wet books after confusion surrounding the damage to the school building had abated.

Meanwhile, Wallops director Robert L. Krieger took an interest in the book-rescue operation and asked some of his people to look into the feasibility of additional rescue measures. The result was the suggestion that NASA's environmental vacuum chamber might be used to restore those volumes not damaged obviously beyond repair. The half-million-dollar airtight chamber ordinarily is used by scientists at the NASA center to simulate space environments.

Miss Parker then selected some 1,000 of the damaged books for an experimental treatment in the chamber. The books were packed into boxes (about 40 books to the box), the boxes were weighed to determine water content before the drying process began, and the books were sealed in the space chamber under vacuum conditions for about a week. Technician Don Vickerman was put in charge of the restoration effort.

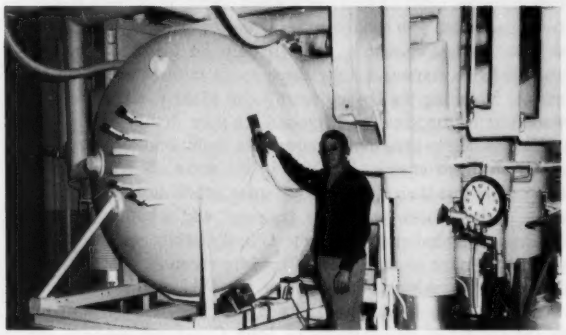
When Vickerman removed the books and weighed them, he found that some 14 liters (30 pounds) of moisture had been removed from the lot. He then proceeded to treat the books chemically by resealing them in the chamber and introducing a sterilization formula, which remained in the vacuum chamber for 48 hours. After ventilating the system for another 72 hours, the chamber was again sealed and the books treated with a second chemical solution to retard mold. At the end of the experiment, which took about two weeks, some 700 of the books had been restored to usable condition. Vickerman donated most of his Christmas vacation to the experiment.

Estimates were that some $3,500 worth of school books were saved at a total expenditure of $250 for the electric power used by the Wallops center. Incalculable was the value of the community spirit engendered as a result of the unexpected aid given by space technology.



Librarian Linda Parker packs water-damaged books into Wallops environmental vacuum chamber.

Wallops' Don Vickerman sets controls to activate book-drying measures in vacuum chamber.



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